DOCUMENT RESUME

ED 302 209 IR 013 568

AUTHOR Durance, Carl M.; Fenton, Shirley L.
TITLE The Network Advantage in Education for the Apple Macintosh.
PUB DATE Nov 86
NOTE 20p.; For the complete journal, see IR 013 556.
PUB TYPE Speeches/Conference Papers (150) -- Journal Articles (080)
JOURNAL CIT Learning Tomorrow. Journal of the Apple Education Advisory Council; n4 p221-240 Win 1988

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Computer Literacy; Computer Managed Instruction; Computer Software; *Computer System Design; Foreign Countries; Higher Education; Information Dissemination; *Information Networks; *Local Area Networks; *Microcomputers
IDENTIFIERS *Apple Macintosh; *University of Waterloo (Ontario)

ABSTRACT

"Waterloo MacJANET," a local area network developed by the University of Waterloo for the Apple Macintosh computer, provides an environment appropriate for developing students' computer-related skills, minimizing both the human and the computing resources needed to support such courses. The system also serves as an efficient distributor of a variety of computer files to large numbers of students while providing security and copyright protection. The files contained in the system include application software; course data files; sample programs and data; and files for exercises, assignments, and quizzes. The MacJANET system for these files was specifically designed to alleviate administrative and management problems while furthering the effectiveness of the Macintosh as a teaching tool. The system, which has been found to provide benefits to users, teachers, and administrators, was used by over 1,500 computer literacy course students in its first year. (10 figures) (EW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

The Network Advantage in Education

For the Apple Macintosh

Carl M. Durance and Shirley L. Fenton

IR013568

BEST COPY AVAILABLE

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Saul ckman

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Waterloo MacJANET, a local area network developed by the University of Waterloo for the Apple Macintosh computer, meets the special needs arising from the use of computers in the classrooms of academic institutions.

This article describes the solutions Waterloo MacJANET offers to such challenges as providing students with an environment appropriate for developing computer-related skills, minimizing both the human resources and the computing resources required to support such courses, and efficiently distributing a variety of computer files to large numbers of students while providing security and copyright protection. Waterloo MacJANET was chosen for the Apple Classroom of Tomorrow™ (ACOT™) project as the networking solution for the Apple Macintosh. As Bob Howard, who works at the ACOT site at West High School in Columbus, Ohio, says, "Waterloo MacJANET. . . is proving to be very vital to our classroom management, as well as opening new doors for activities we can do."

Background

For more than 20 years, the University of Waterloo has had a strong commitment to teaching students how to use computers. The original approach was to introduce students to computers by teaching the basics of computer programming. But because of recent advances in both hardware and software, many students no longer need to have an in-depth knowledge of traditional computer science concepts in order to use a computer as a productivity tool.

The goal of the new introductory computer science course at the University of Waterloo (CS100: Introduction to Computer Usage) is to provide students from all disciplines with the ability to determine when and how a computer might be used for problem solving. To achieve this goal, students are introduced to universal computer tools such as word processors, electronic spreadsheets, and data base management and presentation graphics software.

Extensive practical experience with a personal computer is considered essential to developing these skills. The Macintosh was chosen to support the course because of its consistent and easy-to-use graphical interface—and also because of the abundance of good Macintosh software.

The implementation of such a course to support 600 students per term po a number of administrative and management challenges:

- To provide a computing environment that aids, not hinders, the student development of skills.
- To minimize the human resources required to administer the course.
- To minimize the equipment required to support the course.

A major problem was finding an efficient method of distributing a variety computer files, including:

- Application software
- Course data files
- Sample programs and data
- Files required for exercises, assignments, and quizzes

Using disks to distribute and manage this number of files would have required a major investment of time and effort. Even if unlimited human resources were available, smooth administration of the course materials was still unlikely. Problems with out-of-date application software, errors in problem data sets, missing data files, or bad media were likely to necessitate some disk recalls. Further, how were student files to be safeguarded and how was copyright protection to be provided? It was anticipated that these problems would have a major impact on, if not preclude, the success of the course.

A distribution system that would allow the sharing of software, course data files, and peripherals became a major requirement for course implementation. The solution would also need to provide safeguards for copyrighted software and user files.

The Waterloo MacJANET Solution

To alleviate the administrative and management problems and further the effectiveness of the Macintosh as a teaching tool, software was developed by the University of Waterloo to network the stand-alone machines. Waterloo MacJANET, a descendant of Waterloo JANET for the IBM PC (also developed by the University of Waterloo), is networking software designed specifically to meet the needs of the educational environment.

The system supports a large number of users through workstations connected to a central data and print server.

Waterloo MacJANET for the Macintosh personal computer consists of a Macintosh equipped with a hard disk acting as the network data server, connected to a number of Macintosh workstations using Apple's built-in AppleTalk® hardware. The users share the network server hard disk.

Common software applications and data can be stored on the network server and shared by users of all of the workstations. The students' private files are also stored on the server. Output for an AppleTalk-connected ImageWriter® and/or LaserWriter® printer can temporarily reside (that is, be spooled) on the shared hard disk while awaiting print.

Using the Network

An important design goal of the Waterloo MacJANET network was transparency to the user. Normal Macintosh procedures are used to manipulate the network disks—the same familiar procedures used with regular disks in internal or external disk drives. Similarly, printing a document using the network spooler is as easy as sending a document directly to the printer over AppleTalk.

A user gains access to the network through the Waterloo MacJANET desk accessory (Figures 1 and 2).

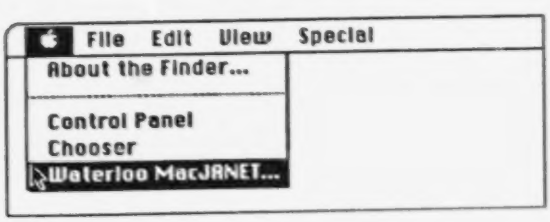
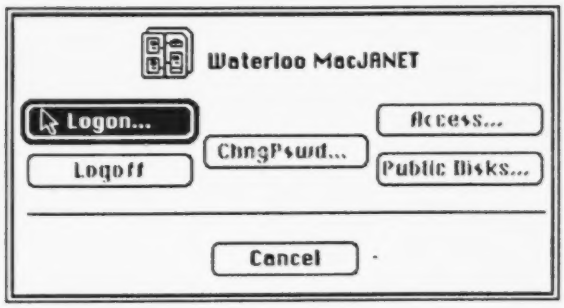
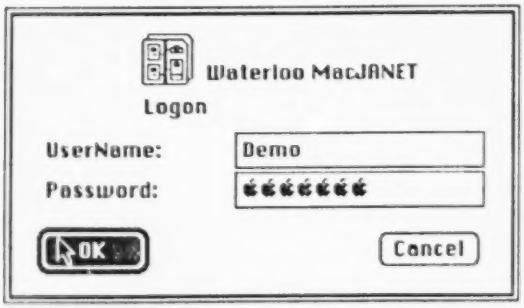


Figure 2
Logging onto Waterloo MacJANET



Along with the user name, a password must be specified, to protect the private data belonging to that user (Figure 3).

Figure 3
Entering User Name



This action, which is called "accessing a network disk," automatically provides access at the workstation to the individual's files on the shared, network server Macintosh. These files appear on the desktop just as if the user had inserted a disk into a disk drive attached to the workstation Macintosh.

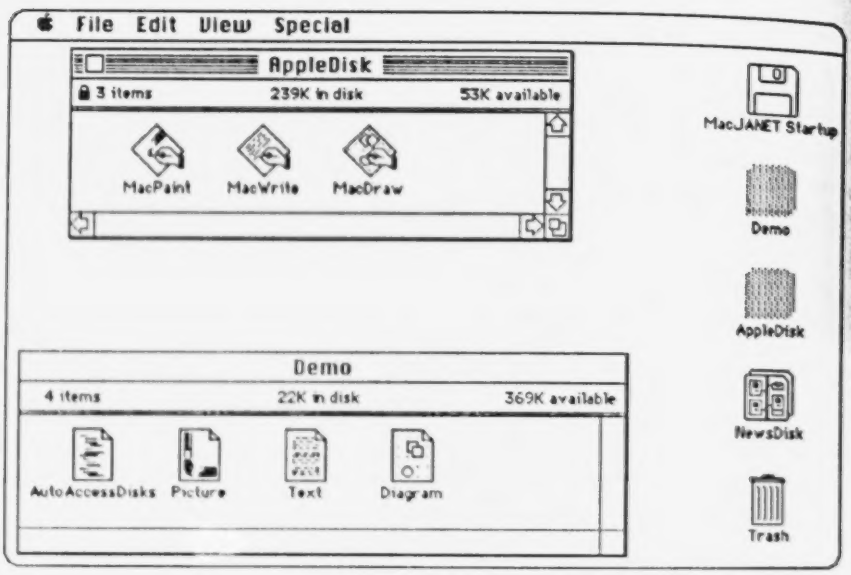
Network disks are used in the same fashion as disks located in the internal or external drives. The network disks are represented by a special disk icon, which may appear in one of four forms—accessed, selected, opened, or opened and selected—according to its state (Figure 4).

Figure 4
Network Disk Icons

Access to selected network disks can be provided automatically to users when they log on. Usually these disks are read-only library disks containing necessary application programs and data files. Because access to these network disks is predefined, the user need not learn the mechanics of the manual procedure to access additional network disks.

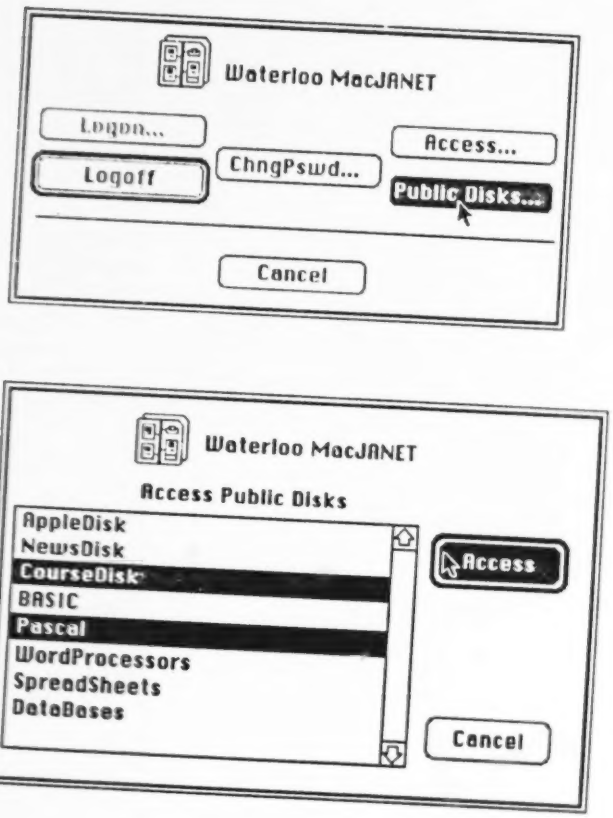
Using the Waterloo MacJANET desk accessory, the user can access other network disks, such as public library disks containing application software or data files. Again, these network disks provide the illusion of real disks in a workstation disk drive (Figure 5).

Figure 5
The Desktop with network disks. The locked disks are public library disks. The Demo disk is a private network disk.



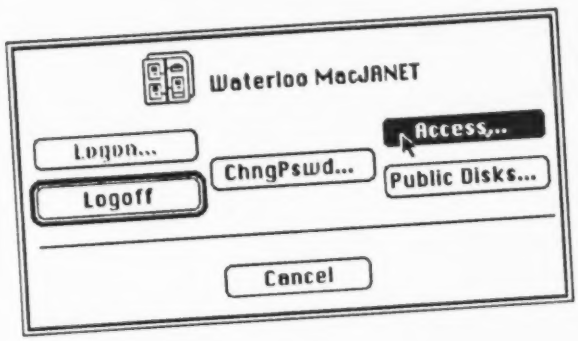
The user can access other public disks by selecting the appropriate network disk names from a displayed list (Figure 6).

Figure 6
Accessing a Public Disk



This list can be limited to a subset of all public disks, according to the user's access restrictions. These shared public library disks are accessed in read-only mode, which is indicated by a padlock icon displayed in the title bar of the disk directory window. In addition, Macintosh application files can be marked as protected, so that users can execute an application but cannot copy the program.

Access to private network disks is allowed if the user specifies both the network disk name and an associated password (Figure 7). Each network disk has a read-only and a read-write password.



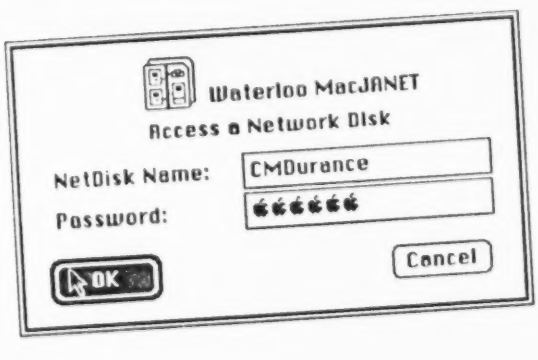


Figure 7
Accessing a Private Disk

Macintosh applications that create temporary work files usually do so on the default disk—typically the disk containing the application program itself. But Waterloo MacJANET uses the startup disk (system disk) in the internal drive of the Macintosh workstation as the default disk even while executing applications. So the temporary work files belonging to the application are created locally on this disk. This has many benefits, but the most important is that it allows these application programs to be shared from read-only library network disks. It also reduces the memory required for a user's private network disk. Finally, using the local disk reduces overall network traffic, thereby increasing network capacity.

Documents to be printed on an AppleTalk-connected ImageWriter or LaserWriter printer can be spooled through the network server. The user simply chooses the name of the network print spooler instead of the actual printer name (Figure 8).

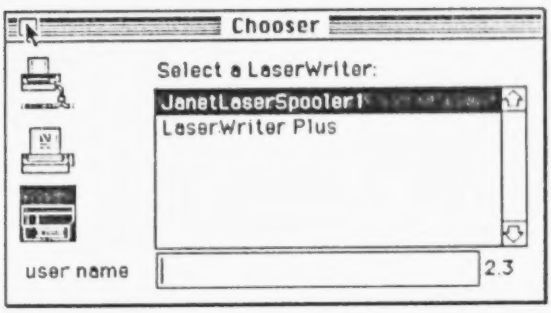
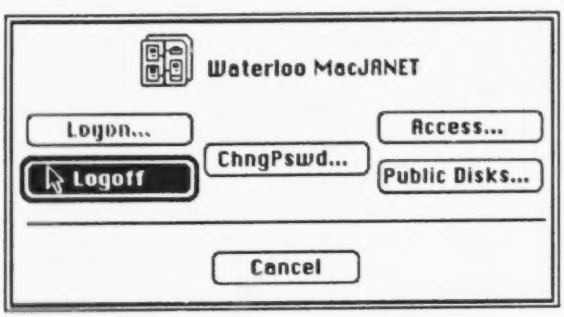


Figure 8
Choosing LaserWriter Spooling

The print data is saved on the network server, and the user is then free to continue using the workstation for other tasks. The network server handles the task of forwarding the data to the printer when it becomes available.

When the user is finished working with the Macintosh, he or she informs the system by using the Waterloo MacJANET desk accessory to log off (Figure 9).



ure 9
ging Off Waterloo JANET

This releases any network disks accessed during the user's session, leaving the workstation ready for the next user.

Benefits for the User

Waterloo MacJANET offers many advantages to the student user at a workstation.

Files belonging to the individual student are stored on the network server, safe from access by others. The necessity for the student to learn about and handle real disks is eliminated; instead, the student can concentrate on the utility of the computer. Optionally, the students can elect to copy their data to and from the network for personal use.

The system can be set up so that access to other network disks is established automatically when the student logs on. The network disks might contain necessary course-related programs, data files, and news documents. Instant access to the course materials through the network provides the student with the most up-to-date information regarding course assignments and news; for example, an extended due date for this week's assignment or a surprise quiz. Also, the student is assured of using the latest course tools and data files to complete any assignments.

Benefits for the Teacher

In addition to the benefits provided to other users, the network offers special advantages for the teacher, eliminating many of the problems inherent in the computer-intensive classroom of today.

Course work such as assignments, sample programs, and data files can be prepared in the students' working environment. Course materials can also be prepared on a stand-alone Macintosh (for instance, at the teacher's home) and later copied to the teacher's network disk. When appropriate, these materials can be copied to a course network disk, which is shared—through read-only access—by students enrolled in that course.

The ability to provide information instantly to the students yields a more spontaneous teaching environment. For instance, the teacher can react immediately to problems with course materials by offering updates, or by providing new course information as needed.

Teachers can access the individual student network disks to track progress and diagnose problem areas in the course work. They can also use their access to the students' network disks to mark course assignments.

The Administrators' Perspective

Waterloo MacJANET stresses ease of use not only for the network user, but also for the system administrator. It was designed to be installed quickly and maintained easily. Most administrative procedures can be invoked from a network workstation, in the same way as standard application software.

The Waterloo MacJANET administration program is located on the system administrator's network disk. The program is run from a Macintosh workstation while the network is operational, thus eliminating the need to shut down the system and disrupt other users who are logged onto the network.

The functions that the administration program provides include directory maintenance, manual or automatic generation of user accounts, and collection of user information. Information gathered in the user directory file includes the name of the user, the associated password, the size of network disk allocation, and access restrictions. The system administrator can easily modify the information contained in this file through the administration program, by adding or removing users or by changing the characteristics of current users.

The network administration facilities are designed to cope with procedures peculiar to the educational environment. Users can be added to the network one by one or hundreds at a time in a single operation. Names can be generated automatically from a specified pattern (Figure 10) or read in from a data file for a more customized effect. Each user is automatically assigned a designated allotment of the network server hard disk for private file storage. Users can be grouped into associated classes, and procedures may be performed simultaneously for an entire class.

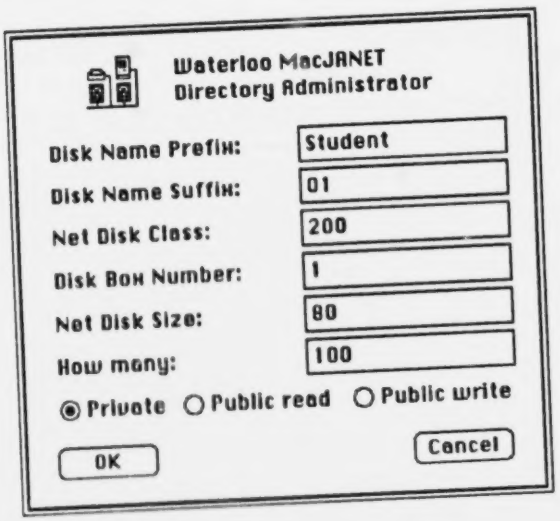


Figure 10
Automatic Generation of User Names. (In this example, users Student01, Student02, and so on, are created.)

Furthermore, an individual's access rights can be restricted to a particular network disk or to certain classes of network disks. This added restriction ensures the security of sensitive information on the network disk.

Use at Waterloo

Waterloo MacJANET has been used at the University of Waterloo for more than a year. The production system is actually composed of three separate networks, each consisting of one Macintosh Plus computer with a built-in 20-megabyte HyperDrive hard disk from General Computer Company, and 15 Macintosh 512K Enhanced workstations connected by the AppleTalk cabling system. ImageWriter printers attached directly to workstations provide output.

In Waterloo MacJANET's first year at the University of Waterloo (prior to its release in October 1986), more than 1,500 students used the system in the CS100 computer literacy course. Waterloo MacJANET provided an effective solution to the computer-related administrative and management problems that faced the CS100 course developers.

Reactions of the course instructors, teaching assistants, and students have been extremely positive. The teacher's time is focused on teaching the course content rather than on preparing handouts. Teaching assistants can devote more time to helping students with course-related questions. And finally, students can concentrate on applying the course concepts—with easy access to up-to-date information and software, and without the need to handle disks.

These same principles can be applied to any course using a computer laboratory. Recently, the Engineering Education Research Centre at the University of Waterloo opened a new Macintosh lab using Waterloo MacJANET to provide controlled computing resources for undergraduates, graduate students, and faculty.

Acceptance of Waterloo MacJANET continues to grow in various areas of the university and at many other educational institutions. All seem agreed that it provides a solution to the problem of networking stand-alone Macintosh computers to form a shared teaching environment.

Carl M. Durance

Carl M. Durance is associate director of the Computer Systems Group at the University of Waterloo.

His areas of interest include computer networking and programming languages in education. He has led research and development projects, such as the Waterloo MacJANET local area network, and has designed courses and workshops on networks in education and the C programming language. He has also written books on these subjects.

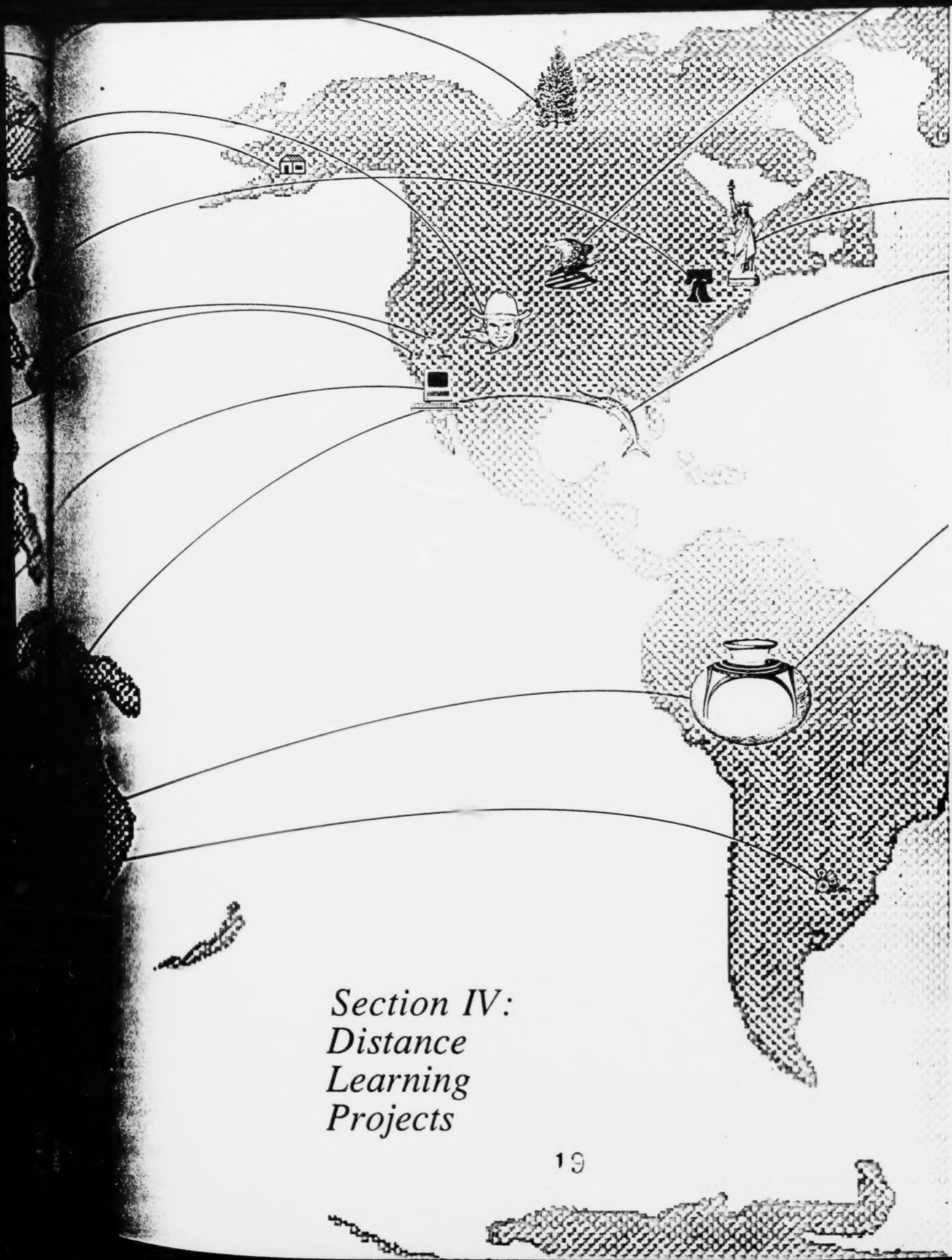
Mr. Durance joined the Computer Systems Group in 1978 after receiving the Bachelor of Math in Computer Science degree at the University of Waterloo. He is currently a candidate for the Master of Math in Computer Science degree.

Shirley L. Fenton

Shirley L. Fenton is manager of project development in the Department of Computing and Communications at the University of Waterloo.

She has been involved in the management of various campuswide computer research projects and the development of several educational software systems. She has developed a number of courses on microcomputer applications and educational networks and has taught those courses in Canada and throughout the Far East. She has also coauthored several articles and books on the use of computer systems in the educational environment.

Ms. Fenton received Bachelor of Environmental Studies and Master of Arts degrees from the University of Waterloo in 1975 and 1977, respectively. She joined the Department of Computing Services at the University of Waterloo in 1978 as a computer consultant and became an adjunct lecturer in 1983. She was appointed manager of project development in 1984 and assistant professor in 1987.



Section IV: Distance Learning Projects

Distance Learning Projects

In these telecommunications projects, multiple technologies have been employed to address the issues of access and equity in education. The three state projects considered here have sought to reach out to their constituents with educational materials broadcast via television, satellite hookups, audio conferencing, and fiber-optic communications, in addition to the computer-based connections discussed in the previous sections. As a result of these hybrid technological configurations, geographically isolated students and teachers are now brought into the mainstream of the educational system. Many innovative projects all over the continent are delivering powerful education programs in nontraditional ways. We present a sampling of them here.

William Bramble describes Learn Alaska, that state's attempt to address remote populations otherwise excluded from a full range of educational opportunities. Beginning with computer conferencing for administrators and computer-based courses for rural high schools, at the height of its development the project grew to include satellite-broadcast instructional programs and video and audio conferencing of advanced-placement and adult courses. Currently, economic limitations have severely constrained full implementation of the system.

As with Alaska's effort to broaden its range of educational services, New York State is directing numerous projects designed to increase participation in the educational process by nontraditional or isolated students. Among its 64 separate distance learning programs, New York utilizes microwave, cable, satellite, and fiber-optic transmissions. Further work with audiographic and computer conferencing contributes to a system that addresses adult literacy, advanced-placement courses in rural areas, staff development, and other areas of concern. As Peter Stoll mentions in his paper, cooperation among diverse political jurisdictions is increasingly important as New York's program expands.

John Southworth provides information on several projects being run in Hawaii to address the need to serve an ethnically diverse and geographically separated student population. Computer-based telecommunications forms the framework for the Hawaii projects, with additional multimedia video and audio components adding depth and interest to student interactions. In his paper, Southworth raises general issues that need to be considered by planners of educational telecommunications projects.